of Men; and that it is frequently made use of for the taking of Films from the Eyes of Horses and other Beasts. I hear also that they sell good quantities of it to the Druggists of *London*, but for what use I know not. This is all I could learn concerning *Calamine*. If I have omitted any thing wherein you are desirous of further Information; or if in any other Concern of this Nature I can be serviceable, you may freely command,

Wrington, Oct. 25. 84. *Yours*, &c.

VIII. *An Arithmetical Paradox, concerning the Chances of Lotteries, by the Honourable* Francis Roberts, *Esq; Fellow of the* R. S.

As some Truths (like the *Axiomes* of *Geometry* and *Metaphysicks*) are self-evident at the first View, so there are others no less certain in their Foundation, that have a very different Aspect, and without a strict and careful Examination rather seem repugnant.

We may find Instances of this kind in most Sciences.

In *Geometry*, That a Body of an infinite Length may yet have but a finite Magnitude.

In *Geography*, That if *Antwerp* be due East to *London*, for that reason *London* cannot be West to *Antwerp*.

In *Astronomy*, That at the *Barbadoes* (and other places between the Line and Tropick) the Sun, part of the Year, comes twice in a Morning to some Points of the Compass.

In

In *Hydroſtaticks*, That a hollow Cone (ſtanding upon its Baſis) being fill'd with Water, the Water ſhall preſs the bottom with three times the Weight, as if the ſame Water was frozen to Ice; and Figures might be contrived to make it preſs a hundred times as much.

Theſe Speculations, as they are generally pleaſant, ſo they may alſo be of good uſe to warn us of the Miſtakes we are liable to, by careleſs and ſuperficial reaſoning.

I ſhall add one Inſtance in *Arithmetick*, which perhaps may ſeem as great a Paradox as any of the former.

There are two Lotteries, at either of which a Gameſter paying a Shilling for a Lot or Throw; the Firſt Lottery upon a juſt Computation of the Odds has 3 to 1 of the Gameſter, the Second Lottery but 2 to 1; neverthleſs the Gameſter has the very ſame diſadvantage (and no more) in playing at the Firſt Lottery as the Second.

It looks very like a Contradiction, that the Diſadvantage ſhould be no greater in playing againſt 3 to 1 than 2 to 1, but it may thus be reſolv'd.

$$\text{Let the} \left\{\begin{matrix} \text{1ſt.} \\ \text{2d.} \end{matrix}\right\} \text{Lottery conſiſt of} \left\{\begin{matrix} 3 \\ 4 \end{matrix}\right\} \text{Blanks and} \left\{\begin{matrix} 3 \\ 2 \end{matrix}\right\} \text{Prizes of} \left\{\begin{matrix} \text{16 pence} \\ \text{2 ſhill.} \end{matrix}\right\} \text{a piece.}$$

In the firſt Lottery the Gameſter hazards a Shilling to win a Groat, and the Chances being equal, it is evident there is 3 to one againſt him.

In the Second Lottery the Gameſter ventures a Shilling againſt a Shilling, and the Lots being 4 to 2, his Diſadvantage is 2 to 1.

And a Lot at either of them being truly worth juſt 8 Pence, (*viz.* the 6th part of 3 times 16 Pence, or twice 2 Shillings) the Diſadvantage muſt be the very ſame

ſame in both Caſes, that is, the Gameſter pays a Shilling for a Lot that is worth but 8 Pence.

The Method of finding this Anſwer being ſomewhat out of the common Road, I ſhall here add it, and thereby infinite Solutions of the ſame kind may be diſcovered.

1ſt Lottery.	*2d* Lottery.
Let $a=$ the number of Blanks.	$m=$ the number of Blanks
$b=$ the number of Prizes.	$n=$ the number of Prizes
$r=$ the Value of a Prize.	$s=$ the value of a Prize.

$1 =$ to what you pay for a Lot, *viz.* a Shilling.

So the Lottery has it's Chances for 1, and the Gameſter his for $r-1$. Now the true Odds conſiſting of the compounded Proportion of the Chances and the Values, *viz.* $\frac{a}{b}$ and $\frac{1}{r-1}$, the Share of the Lottery will be a, and that of the Gameſter $rb-b$. Therefore as the preſent caſe ſtands, the firſt Lottery muſt be $a=3rb-3b$, and by the like reaſoning the ſecond Lottery will be $m=2sn-2n$. Now the Value of a Lot being the Sum of the Prizes divided by the number of Lots, (which muſt be equal in both Lotteries) it yields $\frac{rb}{a+b}=\frac{sn}{m+n}$. So to proceed.

$$\left.\begin{array}{l} a \\ b \\ r \\ m \\ n \\ s \end{array}\right\} = ? \quad \left|\begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\right|\begin{array}{l} a=3rb-3b \\ m=2sn-2n \\ \frac{rb}{a+b}=\frac{sn}{m+n} \\ (*) \\ (*) \\ (*) \end{array}$$

q =

$q = ?$	7	Let $\frac{rb}{a+b} = q$
$7 * \overline{a+b}$	8	$rb = qa + qb$
8×3	9	$3rb = 3qa + 3qb$
$1 + 3b$	10	$3rb = a + 3b$
9, 10	11	$3qa + 3qb = a + 3b$
Scope	12	If $a = o$ to avoid negative Numbers.
11, 12	13	$3b = 3qb$
$13 \div 3b$	14	$q = 1$
12, 14	15	$q > 1$ makes $a < o$ $q < 1$ makes $a > o$
Scope	16	If $b = o$
11, 16	17	$3qa = a$
$17 \div 3a$	18	$q = \frac{1}{3}$
16, 18	19	$q < \frac{1}{3}$ makes $b < o$ $q > \frac{1}{3}$ makes $b > o$
3, 7,	20	$\frac{sn}{m+n} = q$
$20 * \overline{m+n}$	21	$sn = qm + qn$
$21 * 2$	22	$2sn = 2qm + 2qn$
$2 + 2n$	23	$2sn = m + 2n$
22, 23	24	$2qm + 2qn = m + 2n$
Scope	25	If $m = o$
24, 25	26	$2qn = 2n$
$26 \div 2n$	27	$q = 1$
25, 27	28	$q > 1$ makes $m < o$ $q < 1$ makes $m > o$
Scope	29	If $n = o$
24, 29	30	$2qm = m$
$30 \div 2m$	31	$q = \frac{1}{2}$
29, 31	32	$q < \frac{1}{2}$ makes $n < o$ $q > \frac{1}{2}$ $n > o$
15,19,28,32	33	that $a\ b\ m\ n$ may be $> o$, q must be $> \frac{1}{2} < 1$

33, 4 (*)	34	Let therefore $Q =$
7, 34	35	$\frac{rb}{a+b} = \frac{2}{3}$
35 *, 10	36	$3rb = 2a + 2b = a + 3b$
36 −	37	$a = b$
20, 34	38	$\frac{sn}{m+n} = \frac{2}{3}$
38 *	39	$3sn = 2m + 2n$
39 * 2	40	$6sn = 4m + 4n$
23 * 3	41	$6sn = 3m + 6n$
40, 41	42	$4m + 4n = 3m + 6n$
42 −	43	$m = 2n$
1 ÷ 37	44	$1 = 3r - 3$
44 + 3	45	$3r = 4$
2 ÷ n, 43	46	$2 = 2s - 2$
46 + 2	47	$2s = 4$
5 (*)	48	Let $A = 3$
37, 48	49	$B = 3$
45 ÷ 3	50	$R = \frac{4}{3}$, id est, 16 Pence.
6 (*)	51	Let $M = 4$
43, 51	52	$N = 2$
47 ÷ 2	53	$S = 2$ 2 Shillings.